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Geological Survey of Ohio ; Geology, Vol. VII., by PROFESSOR EDWARD ORTON, State Geologist, 1893.

This volume although entitled "Geology" is of a more or less composite character. It is divided into two parts, the first treating of Economic Geology, and the second treating of the Archæology, Botany and Palæontology of the State of Ohio. These various subjects are treated by various authors. Part I. of the volume is divided into four chapters : Chapter I. on the Geological Scale and Geological Structure of Ohio ; Chapter II. on the Clays of Ohio, their Origin, Composition and Varieties ; Chapter III. on the Clay Working Industries of Ohio ; and Chapter IV. on the Coal Fields of Ohio.

Chapter I., by Professor Orton, gives a general summary of the various geological formations comprised in the state, with special reference to those carrying products of economic value. The Geological structure of the state is also briefly but clearly described, including the Cincinnati axis, the Appalachian folds, and various other structural features of the state.

Chapter II., by Professor Orton, discusses the origin, composition, and nature of clays in general, and describes the different kinds found in Ohio. The lowest formation in the state known to have been worked for clay is the Medina shale in the Upper Silurian, and from this up to the Coal Measures numerous other formations contain clays of commercial value. The most important deposits are in the Carboniferous rocks, and especially in the coal mining districts where they are often directly associated with coal. By far the most extensively used deposit in the state is what is known as the Kittanning clay in the Carboniferous series.

Chapter III., by Edward Orton, Jr., is a very exhaustive and an exceedingly valuable article on the clay industries of Ohio. He shows that the manufacture of clay wares in Ohio has increased immensely in the last ten years, so that it is now second only to coal mining among the industries developing the natural resources of the state. The nature and origin of clays and their chemical and physical properties as related to their commercial uses, and the methods of testing them, are treated in detail. The present prosperous condition of the clay industry of the state is shown to be dependent largely upon the manufacture of pottery, paving materials, pipes, refractory materials and building materials. Each one of these classes of

materials, and their manufacture in Ohio, is then discussed. The newest of these industries, and the one which has shown the most marked increase, is the manufacture of paving materials which, in the form of vitrified bricks, have been shown to have remarkable endurance even under heavy traffic. The industry has increased at a wonderful rate during the past five years.

This article presents the subject in a clear and concise manner. It shows a thorough insight into the clay industry and is sure to be of much value to those interested in the development of clay deposits, not only in Ohio but elsewhere.

Chapter IV., by Professor Edward Orton, is a thorough discussion of the coal resources of the state, and a résumé of the work which has been done by the survey in previous years in this field. The author first discusses the origin of coal in general, and shows the gradual development of the peat theory from the time it was originally suggested by Leo Lesquereux until the present. The Ohio coal is shown to have been formed in long narrow belts following the line of an old bay of the Carboniferous ocean, which had for its western limit and shore line the gradually rising Cincinnati axis. The coal, therefore, is to be expected to occur on lines running parallel to this old shore and gradually to disappear in the other direction, *i. e.*, at right angles to the shore.

The coal-bearing rocks underlie 10,000 square miles in eastern Ohio, but coal does not occur throughout all of this area. There are fifteen or eighteen seams of coal of economic value, ten of which are of much importance. In the series of rocks carrying the coal, there are twelve beds of limestone, some of marine and some of brackish water origin, which are often more or less replaced by iron.

The value of coal and the wasteful methods of mining and using it, practiced in Ohio and elsewhere, are severely criticised. It is shown that Ohio has probably, according to two different calculations, 12,000,000,000 and 20,000,000,000 tons respectively of available coal left, and that if the rate of consumption should advance as it has done in recent years until it reached a maximum of 100,000,000 tons yearly, the coal of the state would last, according to two different calculations only one hundred and two hundred years, respectively, while if the rate of increase ceased at 25,000,000 tons yearly, the coal would last five hundred and eight hundred years respectively,

The nature and distribution of the different coal seams are dis-

cussed in full, and the volume is accompanied with ten maps, one showing the general distribution of coal in the state and the other nine showing its distribution over local areas. These maps outline the course of the outcrops of the coal and the probable area underlaid by different seams, so that they will be of very great value to all those interested in the present or prospective development of coal fields. Probably no one feature developed by the Ohio Survey in its many years of existence will be of more economic value than these maps.

The important oil and gas resources of the state are not treated in full, but are briefly discussed in the preface. The most important recent developments in the oil industry are the increased number of discoveries in the Trenton limestone, and the increased production from that source. This formation is now the leading source of illuminating oil in the United States.

The supply of natural gas has greatly decreased in the last few years. In 1890 Professor Orton made the prediction that unless the reckless waste of gas was restrained, the supply would soon be exhausted. At that time the use of gas was at its height and was adding immensely to the welfare of the state, not only in supplying a cheap, clean and convenient fuel to the people of the state, but in attracting new manufacturing industries. The predictions of Professor Orton, therefore, were criticised as entirely unwarranted; but recent developments have verified the justice of his warnings. Most of the gas wells show signs of diminished capacity; many have been completely exhausted, and various industries started, or for some years run on gas, have now had to resort to coal.

The chapter on the Archæology of Ohio is by Mr. Gerard Fowke of the Ethnological Bureau of the Smithsonian Institution. It treats the subject in much detail, under the headings of Palæozoic Man; Enclosures, Roadways and Mounds; The Mound Builders; Indians; Relics.

The chapter on botany, by Professor W. A. Kellerman and W. C. Werner, is a complete list of Ohio plants. It combines not only the information given in previous lists, but also many new determinations, making it much more complete than any other previously published and of especial value to those interested in Ohio botany.

Professor Orton states in the preface of the volume that it is the last official publication of the kind that he expects to prepare. This news will be received with much regret by all geologists, and especially by those who have watched Professor Orton's excellent work carried

on in the face of many disadvantages, not the least among which were small appropriations, ever since he assumed control of the Ohio Geological Survey in 1884. A comparison of the state of knowledge on Ohio geology at that time and at the present speaks for itself as to the efficiency of the work he has carried on. In previous years, under the direction of Professor Newberry, many of the most important features of the geology of the state were made known, but many were left undisclosed, and it is to Professor Orton that we owe our knowledge of these, as well as the systematic presentation of many former discoveries. Not only has Professor Orton brought out many facts of very great geological importance, but he has also developed the economic side of the question in an admirable manner, thus rendering the survey useful not only to the scientist, but also to the vast mass of the citizens of the state for whose good the appropriations for a geological survey were especially intended. The collection of purely scientific data in a region is necessarily the first step in the work of a geological survey, and is of great value to all geologists; but he who stops his work here does not fulfill the objects for which appropriations for geological surveys are usually made. The average citizen is not a geologist; purely geological discussions are unintelligible to him. He can draw no deductions from them, and the duty of one in charge of a geological survey is to draw economic deductions from his scientific studies, and publish them in a form which can be understood by the mass of the people of the community taxed to carry on such work. Many who have charge of surveys fail to do this, either because they do not realize its importance, or because they have a weak-minded idea that to make economic publications is unworthy of them.

Professor Orton has in an admirable way given to the people of Ohio all the economic results possible. He has in his various publications first presented his purely geological data, and has then discussed in detail all conclusions therefrom which could be of material benefit to the people of the state. He has thus accomplished the highest objects of a geological survey, and the thanks of the people of Ohio and of the country at large are due him. Most prominent among his works on the economic resources of the state are the treatises on petroleum and natural gas, embodied in Preliminary Reports of Progress, 1886; Vol. VI., 1888, and First Annual Report, 1890. These publications have made him an authority on the subjects

discussed, and have materially assisted in the development of oil and gas resources, not only in Ohio but elsewhere. His other publications on the clays, coal, and other resources of the state are no less valuable, and it may be safely said that no state geological survey has ever been of more advantage to the people of the state than the Geological Survey of Ohio under Professor Orton.

R. A. F. PENROSE, JR.

Geological Survey of Ohio, Vol. VII., *Palæontology*.

A valuable addition to the palæontology of the state of Ohio is included in this volume. Professor R. P. Whitfield publishes in chapter III. a series of papers on the faunas of the Lower and Upper Helderberg, the Marcellus shales, the Huron and Erie series, the Maxwell limestone (equivalents of the St. Louis and Chester beds of Illinois) and the Coal Measures. Following this are articles by Professor C. L. Herrick, Dr. A. F. Foerste, and Mr. E. O. Ulrich, on various special groups (Lower Silurian, Clinton and Waverly). Chapter VI. by Professor Claypole and A. A. Wright describes the fossil fish of the Ohio shale and is a continuation of Professor Newberry's work in this line. With the exception of chapter VI., the descriptions here given have been for the most part already published elsewhere, so that particular comment seems to be unnecessary. Their especial value here consists in the fact that they have now been collected together, and by the generosity of the state become readily accessible to a much larger circle of scientific readers. The paper on the Clinton is a distinct addition to the somewhat scanty literature of this formation. Twenty-nine forms are found to be common to the Clinton of Ohio and the original Clinton of New York state, though the exact parallelism is not altogether clear, and on the other hand an examination of the cuts shows a strong resemblance, or indeed an identity of many of these Clinton with well-known Niagara types. Thus *Calymene Vogdesi* would seem to present no tangible points of difference from *C. Blumenbachi* and *Illænus madisonensis variety depressus*, as figured, could with difficulty be distinguished from *Illænus insignis* as figured by Hall (Twentieth Rept. N. Y. Mus., Pl. 22, Fig. 14). The author has, however, taken much pains to point out differences and likenesses of allied forms, and often frankly acknowledges the difficulties of separating Clinton and Niagara types.

E. C. QUEREAU.